Water calorimetry for proton therapy

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Stellingen

behorende bij het proefschrift

Water calorimetry for proton therapy

Implementing a primary dose measurement standard

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1. The fact that calorimetry is rarely performed outside of standards laboratories shows that it is more challenging than is apparent from research articles purporting the feasibility of in-clinic calorimetry.

2. The inclusion of complex numerical models in the measurement chain of primary standards undermines the robustness that is essential for quality assurance. *(Chapter 6.2)*

3. Though it is not a big surprise that H_2-saturation works in low dose rate scattered beams, vigilance is called for when using it in scanned beams because of the spatial distribution of the dose-rate. *(Chapter 6.1.1)*

4. In scattered-beam proton calorimetry with H_2-saturated water, the uncertainty due to radiolysis is necessarily the same as in photon calorimetry. *(Chapter 3.6.2)*

5. The uncertainties due to heat transfer in the scattered proton beam can be reduced to the same level as currently achieved in photon calorimetry by modest improvements in the spatial and temporal homogeneity of the dose delivery. *(Chapter 5.7, 6.3.1)*

6. There are no big numerical issues that prevent building a detailed heat transfer model for scanned proton beams. However, since measured beam currents would be required for each individual spot, the model cannot be seen separate from its input. This creates serious challenges in validating the models. *(Chapter 6.2)*

7. Medical doctors (in consultation with their clinical physicists) should establish dose uncertainty limits for proton- and ion-therapy based on clinical data and well characterized dose-response models.

8. Improvements in patient characterization (anatomy and radiosensitivity) will cause the patient population to become increasingly stratified in terms of dose-response assessment. This will result in tighter requirements on dose uncertainty limits for both clinical therapeutic doses and primary metrology.

9. Fundamental research opportunities are among the first casualties if the work gets entangled with patent applications due to an overzealous commitment to valorisation.

10. Unless there is a definite push towards open access publishing and a relinquish from the adage 'publish or perish', a vast section of scientific literature will become unreachable due to the joint impediment of pay-wall prices and the needle-in-haystack effect.

11. Politicians appear to prefer the method of 'quantum tunnelling' through artificial barriers to improve the average tuition level of the student population rather than being concerned about the level of the entire societal ensemble.